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54 Method for cleaning textiles with cyclic siloxanes.

57 A method is disclosed for cleaning textiles using cyclic dimethylsiloxanes as a cleaning fluid for removing soil spots. The useful siloxanes include octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane, and dodecamethylcyclohexasiloxane.

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1 METHOD FOR CLEANING TEXTILES WITH CYCLIC SILOXANES

5 The present invention relates to a method for removing soil from textiles using cyclic dimethylpoly-siloxanes. In particular, this invention relates to the use of cyclic dimethylpolysiloxanes for removal of oily/greasy stains from textiles.

10 Textile products such as fabrics, carpets and upholstery often develop prominent stain spots from inadvertent contact with foodstuff and other materials containing grease and oils. Various organic solvents such as alcohols, petroleum hydrocarbons, and chlorinated hydrocarbons have been used in cleaning compositions adapted for direct application to fabric as spot removers.

15 Several approaches to formulating spot cleaning compositions are known. For instance, nonresidue cleaners are formulated with volatile components only. After dissolving, mobilizing, and removing the stained material, such formulations are intended to completely evaporate leaving no residue components on the textile. Other cleaning compositions employ a combination of solvent and solid, absorbent particles. The solvent mobilizes the soil and the absorbent solid attracts the soil and solvent to itself. The residue of absorbent solid is intended to be easily removed from the textile by brushing or vacuuming. Yet another approach involves liquid detergent compositions which have been adapted as prewash spot removers. These compositions usually contain concentrated synthetic surfactants with alcohol or other solvents. When used as a prewash spot remover, the nonvolatile surfactant components remain on the textile as a residue which is removed by a conventional home laundry operation. In the aqueous wash, the prewash spot

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1 remover composition additionally functions in the manner of a heavy-duty laundry detergent.

While known spot cleaning compositions effectively remove some stains, other types of stains may be unaffected
5 or only incompletely removed by the compositions. In other cases, the cleaning composition itself may damage or leave a residue on the textile in such a way that a visible ring occurs around the treated area. It is an object of the present invention to reduce the problems associated with the
10 prior art cleaning compositions by providing a new method of cleaning stains using volatile silicone fluids that effectively mobilize oil and grease stains, are nondamaging to a wide range of textiles both synthetic and natural, and leave no residue or visible ring on treated textiles.

15 It is known from U.S. Patent No. 4,324,595, to remove tacky adhesives from substrates by using octamethylcyclotetrasiloxane fluid to detackify the adhered adhesive. The process is taught to be particularly useful for removing tacky adhesives from human skin, but it is also indicated
20 that the process is applicable to removing tacky adhesives from a wide range of substrates including textiles. However, this patent teaches the removal of only tacky adhesives, it does not suggest removing oil and grease stains with cyclic dimethylsiloxanes.

25 Stain removing compositions are disclosed in Japanese Patent Publication Kokai No. (1974)-35681, which contain small amounts (0.5 to 10 weight percent) of silicone oil combined with cleaning solvents such as trichlorethane and petroleum hydrocarbons. Although the type of silicone oil employed is not further identified, it is taught that the
30 silicone remains on the fabric after cleaning to provide continuing water repellency and soil resistance for the fabric. Consequently, it is apparent that this publication

1 does not contemplate the use of completely volatile cyclic dimethylpolysiloxanes.

An aerosol type aqueous cleaning composition is disclosed in Japanese Patent Publication Kokai
5 No. (1978)-56203, which contains nonionic surfactant, alkanolamine, glycol ether, alcohol, propellant, and 0.02 to 0.1 weight percent of linear dimethylpolysiloxane with 2 to 7 silicon atoms per molecule. This publication discloses only the use of very low amounts of linear dimethylpolysiloxanes
10 and does not contemplate the use of larger, solvent-effective amounts of the cyclic dimethylpolysiloxanes.

The use of tetraethoxysilane as a solvent for removing grease from textiles is disclosed in Russian Patent Publication 979548-A. However, tetraethoxysilane is not
15 stable in contact with water and may hydrolyze forming alcohol and silica solids.

A process for dry cleaning and waterproofing of fabrics is disclosed in U.S. Patent No. 3,123,494 which process employs a silicone composition diluted in typical dry
20 cleaning solvents. The silicone compositions recommended are mixtures of linear dimethylpolysiloxane fluids and cross-linked methylsiloxane resins. Excess liquid cleaning mixture is removed from the textiles by centrifuging but retained silicone provides a continuing waterproofing effect on the textile. Again, it is apparent that this publication does
25 not contemplate the use of completely volatile cyclic dimethylpolysiloxanes as a cleaning solvent.

Liquid cleaning compositions for removing dirt and grit from solid surfaces are disclosed in U.S. Patent
30 No. 2,955,047. The compositions contain surfactants, water, water-miscible organic solvent, and an oil-in-water emulsion of dimethylpolysiloxane oil. The specified siloxanes are linear polymers with viscosities in the range of 200 to 350

1 centistokes. The siloxane polymer is said to impart a high
glossy polish to the treated surfaces by depositing a
monomolecular film on the surface. Somewhat similarly, U.S.
Patent No. 2,993,866 teaches an aerosol glass cleaner
5 composition containing isopropanol, fluorochlorohydrocarbon
propellants, and linear dimethylpolysiloxane having a
viscosity of about 200 centistokes.

An all purpose cleaner composition containing a
mixture of surfactants, isopropyl alcohol, and a silicone
10 defoaming agent is disclosed in U.S. Patent No. 4,311,608.
The silicone defoaming agent is an oil-in-water emulsion of
dimethylsiloxane polymer.

A cleaner (apparently a wiper type) impregnated
with a composition containing mineral oils or alcohols with
organopolysiloxanes is disclosed in Japanese Patent
15 Publication Kokai No. (1975)-161059. The organopolysiloxanes
are characterized by having a viscosity of not more than 30
centipoise at 20°C.

This invention concerns a method for cleaning
20 textiles which comprises applying to a soiled textile a
liquid composition containing an effective amount to aid soil
removal of a cyclic siloxane selected from the group
consisting of octamethylcyclotetrasiloxane, decamethylcyclo-
pentasiloxane, and dodecamethylcyclohexasiloxane and removing
25 from the textile a combination of soil and cyclic siloxane.

In use, the novel textile cleaning compositions are
applied to a soiled area of clothing, carpet, or other
textile by spraying, pouring, or from a cloth or sponge
applicator. The composition may be rubbed or brushed into
30 the textile to facilitate loosening and dissolving the soil
components. The soil-solvent combination is then removed
from the textile by any of the well known methods such as
blotting with absorbent material, absorption unto particulate

1 material followed by vacuuming, or a conventional home
laundry operation.

5 The cyclic siloxanes employed in the liquid
cleaning and spot removing compositions of this invention are
available commercially and are made by well known methods
such as, for example, the hydrolysis and condensation of
dimethyldichlorosilane.

10 Compared with the linear polydimethylsiloxanes the
cyclic siloxanes employed according to this invention are
relatively volatile materials having boiling points below
about 250°C at 760 mm Hg. A single cyclic siloxane may be
used in the liquid cleaning composition or any mixture of two
or more of the cyclic siloxanes may be used. Specifically
15 preferred cyclic siloxanes for use in this invention are
octamethylcyclotetrasiloxane, decamethylcyclopentasiloxane,
and dodecamethylcyclohexasiloxane. It should be understood
that useful cyclic siloxane mixtures may contain, in addition
to the preferred cyclic siloxanes, minor amounts of other
cyclic siloxanes including hexamethylcyclotrisiloxane or
20 higher cyclics such as tetradecamethylcycloheptasiloxane.
Generally the amount of these other cyclic siloxanes in
useful cyclic siloxane mixtures will be less than about 10
percent based on the total weight of the mixture.

25 The amount of cyclic siloxane used in the liquid
cleaning compositions of this invention is not critical so
long as the amount used is effective to aid soil removal from
textiles. In general, the cleaning composition may contain,
for example, from 1 to 100 percent by weight of the cyclic
siloxanes. It is preferred that the cleaning composition
contain from 5 to 100, or more preferably 10 to 100, percent
30 by weight of the cyclic siloxanes.

Other adjuvants may be included in the liquid
cleaning compositions of this invention such as conventional

1 cleaning solvents, absorbent solid particulate materials,
synthetic builders, water soluble organic detergent
compounds, and cationic antistatic substances.

5 For example, nonresidue spot cleaning compositions
may contain conventional cleaning solvents mixed with cyclic
siloxanes according to the present invention. Any
conventional cleaning solvent having a boiling point below
about 250°C can be mixed with the cyclic siloxanes to prepare
a liquid composition useful in the present invention. Useful
10 additional cleaning solvents include alcohols such as
isopropanol and butanol, petroleum hydrocarbons such as
mineral spirits, and chlorinated hydrocarbons such as
methylene dichloride, tetrachloroethylene, and trichloro-
ethylene. Surprisingly, it has been found that a mixture of
15 cyclic siloxane and conventional cleaning solvent is more
effective at mobilizing stains than is either the cyclic
siloxane or the conventional solvent alone. Mixtures of
cyclic siloxanes and conventional solvents selected from the
group consisting of petroleum hydrocarbons and chlorinated
20 hydrocarbons are especially effective. Mixtures containing
about 30 to 70 percent by weight of conventional cleaning
solvent and 30 to 70 percent by weight of the cyclic siloxane
are preferred because of their superior ability to mobilize
stains.

25 Cleaning compositions of the solvent/absorbent
class are also useful in the method of this invention. Such
cleaning compositions may contain in addition to the cyclic
siloxane any of the absorbent materials known for such
applications. Useful absorbent materials include mineral
particulates such as silica, talc, diatomaceous earth,
30 kaolinite; organic particulates such as starch and modified
starch, nut shell flour, and ground rice hulls; and synthetic
porous polymers such as the urea-formaldehyde polymer

1 particles described in U.S. Patent No. 3,910,848, which more
fully describes the polymer particles. The absorbent
material is generally used in amounts of about 5 to 40
percent based on the weight of cleaning solvent in the
5 composition.

Cleaning compositions of the solvent/absorbent
class may also include a cationic antistatic agent to
facilitate the removal of the particulate material during
brushing or vacuuming of the textile material. Useful
10 cationic antistats include quaternary nitrogen salts that
contain at least one C₁₀ to C₂₄ aliphatic hydrocarbon
substituent on the nitrogen such as stearyltrimethylammonium
chloride. Antistatic agents are typically employed in
amounts of about 0.1 to 3 percent by weight based on the
15 total weight of the cleaning composition.

The method for cleaning textiles of this invention
also includes the use of prewash spot remover compositions
containing nonvolatile surfactant components in addition to
cyclic siloxane solvent. Such prewash spot remover
20 compositions will generally include a water soluble organic
detergent material and synthetic builders in combination with
the cyclic siloxane solvent. Detergent compounds useful in
prewash spot removers are the anionic, nonionic, zwitterionic
and ampholytic surfactant compounds. Such detergent
25 compounds are well known to those skilled in the detergent
art. Exemplary detergents are described in the well-known
books entitled "Surface Active Agents" by Schwartz and Perry
and "Surface Active Agents and Detergents" by Schwartz, Perry
and Berch, both by Interscience Publishers, New York, N.Y.

Especially preferred detergents are the nonionic
30 surfactants which are condensation products of polyethylene
oxide with an organic hydrophobic compound which is usually
aliphatic or alkylaromatic in nature. Exemplary nonionic

1 surfactants are polyethylene oxide condensates of nonyl
phenol and polyethylene oxide condensates of myristyl
alcohol.

5 Generally, from about 10 to 80 percent by weight of
surfactants may be used in the prewash spot removing composi-
tions of this invention. More preferred prewash spot
removing compositions contain 30 to 70 percent by weight of
nonionic surfactants.

10 Prewash spot removers of this invention may also
contain a variety of builder compounds such as sodium
tripolyphosphate, sodium carbonate, sodium silicate, the
alkali metal, ammonium and substituted ammonium salts of
oxydisuccinic acid, oxydiacetic acid, carboxymethyloxymalonic
15 acid, carboxymethyloxysuccinic acid, lactoxysuccinic acid,
citric acid, mellitic acid, tetrahydrofuran tetracarboxylic
acid, polyacrylic acid, nitrilotriacetic acid, oxidized
starches and mixtures thereof. Builders are generally added
to prewash spot removing compositions in amounts ranging from
0. to about 50 percent by weight based on the weight of the
20 total composition.

The liquid compositions of the present invention
are especially adapted for direct application to stains and
soils on fabrics and other textiles. The compositions can be
applied to soiled textiles by any of the commonly used
25 methods. The liquid compositions may be poured or sprayed
onto the stains. Alternatively the composition may be
brushed or rubbed onto the stained or soiled area using
absorbent items such as brushes, paper towels, cloth or
sponges that contain the cleaning composition.

30 Once the cleaning composition has been applied to
the soiled textile, the cyclic siloxane acts to dissolve
and/or loosen the soil which it contacts. The mobilized soil
is then more easily removed from the textile in combination

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1 with the cyclic siloxane. The cyclic siloxane/soil
combination can be removed from the textile by any convenient
method such as blotting the textile with a dry absorbent
material. The textile may be blotted, for example, with
5 sponges, paper towels, or cloth towels. Alternatively, the
soil/cyclic siloxane combination may be removed by processes
such as brushing, vacuuming, or conventional home laundry
operations. Brushing and vacuuming are especially useful if
solid, absorbent particles are employed in the liquid
10 cleaning composition. Conventional home laundry is the
preferred method of removal when nonvolatile surfactants are
used in combination with cyclic siloxane in the cleaning
composition.

The cyclic siloxanes are sufficiently volatile that
15 any residual cyclic siloxane on the textile, after removal of
the soil, readily volatilizes to leave the treated area dry
as well as clean.

The method of the present invention can be used to
remove a wide variety of soils and stains. The cyclic
20 siloxane is especially effective at removing oil and grease
spots or stains. One special advantage of the cyclic
siloxanes as cleaning solvents is that the formation of a
secondary stain ring is either eliminated or greatly reduced
in definition. Another advantage is that the cyclic
25 siloxanes are essentially nontoxic and nonharmful in the
environment.

Furthermore, the cyclic siloxanes can be used with
a wide variety of fabrics without harming or in any way
changing the appearance of the fabric. The method of
cleaning of this invention can be used on all types of
30 textiles including carpets and fabrics used for clothing or
upholstery.

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1 The following examples are presented to illustrate
the invention, but the examples in no way limit the scope of
the invention as more fully set out in the claims.

5 Artificial sebum employed in the following examples
was prepared from a base mixture of palmitic acid (5 g),
stearic acid (2.5 g), coconut oil (7.5 g), paraffin (5 g),
spermaceti (7.5 g), olive oil (10 g), squalene (2.5 g),
cholesterol (2.5 g), oleic acid (5 g), and linoleic acid
10 (2.5 g). A melted (120°F) 5 g portion of the base mixture
was combined with oleic acid (4 g) and triethanolamine (8 g)
and agitated at 120°F until homogenous. Then air filter dirt
(12 g, +200 mesh) and deionized water (100 ml) were added and
the mixture agitated for ten minutes. Additional deionized
15 water (900 ml) was added and the mixture was agitated in a
homogenizer for ten minutes. The mixture was stored in a
100°F oven and shaken well before using for staining.

Example 1

20 The following experiments demonstrate the stain
removal ability of cyclic dimethylpolysiloxanes on 100
percent cotton fabric.

25 Cotton fabric test pieces were prepared with
approximately 1 inch diameter stains of used motor oil,
cooking oil and artificial sebum. -The stains were aged at
room temperature for 24 hours. Stains were cleaned by
placing the fabric pieces on several absorbent paper towels
and rubbing the stained area for 20 seconds with a paper
towel saturated with the cleaning fluid.

30 The cyclic siloxane fluids tested were (A) octa-
methylcyclotetrasiloxane, (B) decamethylcyclopentasiloxane,
(C) a cyclic siloxane mixture of about 91 percent by weight
octamethylcyclotetrasiloxane and about 8 percent by weight
decamethylcyclopentasiloxane, and (D) a cyclic siloxane
mixture of about 1.3 percent by weight

1 octamethylcyclotetrasiloxane, about 69.3 percent by weight
decamethylcyclopentasiloxane and about 29.1 percent by weight
dodecamethylcyclohexasiloxane. For comparison, hexa-
methyldisiloxane, mineral spirits, tetrachloroethylene,
5 isopropyl alcohol, and xylene were also used to clean the
stains.

After drying, the cleaned fabric pieces were rated
visually for the degree of stain removal according to the
following scale:

- 10 5 = Complete removal
 4 = Slight remaining stain
 3 = Moderate stain remaining
 2 = Slight removal of stain
 1 = No change in stain

15 The ratings were made by comparison of the test
pieces with a standard series of exemplary stains in a black
box using a fluorescent light source. Deviations between the
test pieces and the standard stains are indicated by
fractional ratings.

20 The used motor oil tended to form a dual stain
containing a smaller sludge portion nearer the center and a
larger oil portion which spread out more from the point of
application. Some differences in the cleaning of the two
portions of these stains were observed and consequently the
cleaning of each portion was separately rated. The results
25 of the visual rating are presented in Table 1.

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1 TABLE 1: STAIN REMOVAL ON COTTON FABRIC

	Cleaning Fluid	Stain			
		Motor Oil (Sludge)	Motor Oil	Cooking Oil	Artificial Sebum
5	A	2.5	2.0	5.0	3.0
	B	2.5	2.0	5.0	3.0
	C	2.9	2.0	4.8	2.8
	D	2.8	2.5	5.0	3.0
	$[(CH_3)_3Si]_2O$	2.7	2.9	4.3	3.0
10	Mineral Spirits	2.9	2.5	4.9	3.0
	Tetrachloroethylene	2.5	2.5	5.0	2.8
	Isopropyl Alcohol	1.0	1.0	4.5	1.0
	Xylene	2.8	3.5	5.0	1.0

15 Example 2

The stain removal testing procedure of Example 1 was repeated using a 65/35 polyester/cotton fabric. The results of the black box visual ratings of the cleaned fabric are presented in Table 2.

20 TABLE 2: STAIN REMOVAL ON 65/35 POLYESTER/COTTON FABRIC

	Cleaning Fluid	Stain			
		Motor Oil (Sludge)	Motor Oil	Cooking Oil	Artificial Sebum
	A	2.5	3.0	5.0	3.0
25	B	3.0	3.0	5.0	3.0
	C	2.9	3.0	5.0	3.0
	D	3.5	3.5	5.0	3.0
	$[(CH_3)_3Si]_2O$	2.9	-	-	3.0
	Isopropyl Alcohol	1.0	1.0	3.0	3.0
30	Xylene	3.0	4.0	5.0	3.0

Example 3

The stain removal testing procedure of Example 1 was repeated using a 100 percent polyester fabric. The results of the black box visual ratings of the cleaned fabric are presented in Table 3.

TABLE 3: STAIN REMOVAL ON 100% POLYESTER FABRIC

	<u>Cleaning Fluid</u>	<u>Stain</u>			
		<u>Motor Oil (Sludge)</u>	<u>Motor Oil</u>	<u>Cooking Oil</u>	<u>Artificial Sebum</u>
10	A	2.0	5.0	5.0	1.0
	B	2.0	5.0	5.0	1.0
	C	2.0	5.0	5.0	1.0
	D	2.0	5.0	5.0	1.0
	$[(CH_3)_3Si]_2O$	1.5	5.0	4.2	1.0
15	Mineral Spirits	3.0	5.0	4.1	1.0
	Tetrachloroethylene	3.5	5.0	4.9	1.0

Example 4

The stain removal testing procedure of Example 1 was modified by heat setting the stain before cleaning. Stains were set by placing the fabric in an automatic clothes dryer at the high temperature setting for two cycles of 60 minutes each. Polyester (100%) fabric was used in these tests. Results of the black box visual ratings of cleaned fabric are presented in Table 4.

TABLE 4: STAIN REMOVAL OF HEAT SET STAINS

	Cleaning Fluid	Stain			
		Motor Oil (Sludge)	Motor Oil	Cooking Oil	Artificial Sebum
5	A	2.0	5.0	5.0	1.3
	B	2.0	5.0	4.9	1.6
	C	2.0	5.0	5.0	1.0
	D	2.0	5.0	4.7	1.2
	$[(CH_3)_3Si]_2O$	2.0	5.0	4.8	1.2
10	Mineral Spirits	3.0	5.0	4.8	1.2
	Tetrachloroethylene	3.5	4.9	5.0	1.0

Example 5

The following experiments demonstrate the relative efficiency of cyclic dimethylpolysiloxanes in spreading oil stains on fabric. The degree of spreading of the stain relates to the extent of mobilization of the stain by the solvent being tested. Generally, the more effectively a stain can be mobilized, the more easily and completely it can be removed from the fabric.

Cotton fabric test pieces (8 inch x 8 inch) were placed in an embroidery hoop and approximately 1 ml of cooking oil was applied to the center of the fabric. Stains were aged at room temperature for 24 hours. The fabric was then positioned under a burette filled with the cleaning fluid. With the burette tip just above the center of the stain, a 0.5 ml portion of the cleaning fluid was dropped on the stain. The fabric was allowed to dry at room temperature and the size of the resulting stain was measured. Generally the stains were circular or slightly oval in shape. The approximate areas of the stains after the spreading process with various cleaning fluids are shown in Table 5. In the case of oval shaped stains, approximate areas were calculated

1 as if the stain were circular using a diameter equal to the
 average of the length and width of the oval. The cyclic
 siloxane fluids tested are described in Example 1.

TABLE 5: SPREADING OF COOKING OIL STAINS ON COTTON

5	<u>Cleaning Fluid</u>	<u>Stain Area (sq. in.)</u>
	None	0.8
	A	>50
	B	>50
	C	>50
10	D	26
	$[(CH_3)_3Si]_2O$	5.9
	Mineral Spirits	>50
	Tetrachloroethylene	4.9

15 Example 6

The stain spreading procedure of Example 5 was repeated using 100% polyester fabric test pieces. The approximate stain areas after spreading are shown in Table 6.

TABLE 6: SPREADING OF COOKING OIL STAINS ON POLYESTER

20	<u>Cleaning Fluid</u>	<u>Stain Area (sq. in.)</u>
	None	0.8
	A	16
	B	16
	C	19
	D	22
25	$[(CH_3)_3Si]_2O$	13
	Mineral Spirits	25
	Tetrachloroethylene	16

30 Example 7

The stain spreading procedure of Example 5 was repeated using a 65/35 polyester/cotton fabric. Approximate stain areas after spreading are presented in Table 7.

	<u>Cleaning Fluid</u>	<u>Stain Area (sq. in.)</u>
5	None	0.8
	A	33
	B	33
	C	33
	D	33
10	$[(CH_3)_3Si]_2O$	27
	Mineral Spirits	38
	Tetrachloroethylene	5.9

15 The following experiments demonstrate the stain spreading efficiency of blends of cyclic dimethylpolysiloxanes and conventional cleaning fluids such as mineral spirits and tetrachloroethylene.

Cooking oil stains were prepared on 65/35 polyester/cotton fabric and the spreading procedure of Example 5 was repeated except that a 1 ml portion of a blend of cleaning materials was dropped on the stain. Octamethylcyclotetrasiloxane was blended in various proportions by weight with either mineral spirits or tetrachloroethylene to prepare the cleaning materials. The approximate stain areas after spreading are shown in Table 8.

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1 TABLE 8: SPREADING OF STAINS WITH BLENDS OF CYCLIC
 SILOXANES AND CONVENTIONAL CLEANING FLUIDS

	Conventional Cleaning Fluid in Blend	Ratio of Cyclic Siloxane to Conventional Fluid	Stain Area (sq. in.)
5	Mineral Spirits	5/95	40
	Mineral Spirits	10/90	39
	Mineral Spirits	20/80	40
	Mineral Spirits	30/70	47
	Mineral Spirits	40/60	>50
10	Mineral Spirits	50/50	>50
	Mineral Spirits	60/40	>50
	Mineral Spirits	70/30	>50
	Mineral Spirits	80/20	34
	Mineral Spirits	90/10	27
15	Tetrachloroethylene	5/95	13
	Tetrachloroethylene	10/90	17
	Tetrachloroethylene	20/80	10
	Tetrachloroethylene	30/70	25
	Tetrachloroethylene	40/60	>50
20	Tetrachloroethylene	50/50	>50
	Tetrachloroethylene	60/40	22
	Tetrachloroethylene	70/30	>50
	Tetrachloroethylene	80/20	22
	Tetrachloroethylene	90/10	31

25 Example 9

 The stain spreading procedure of Example 8 was repeated using decamethylcyclopentasiloxane blended in various proportions by weight with either mineral spirits or tetrachloroethylene. The approximate stain areas after spreading are presented in Table 9.

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TABLE 9: SPREADING OF STAINS WITH BLENDS OF CYCLIC
SILOXANE AND CONVENTIONAL CLEANING FLUIDS

	Conventional Cleaning Fluid in Blend	Ratio of Cyclic Siloxane to Conventional Fluid	Stain Area (sq. in.)
5	Mineral Spirits	5/95	28
	Mineral Spirits	10/90	>50
	Mineral Spirits	20/80	>50
	Mineral Spirits	30/70	34
	Mineral Spirits	40/60	>50
10	Mineral Spirits	50/50	31
	Mineral Spirits	60/40	>50
	Mineral Spirits	70/30	35
	Mineral Spirits	80/20	38
	Mineral Spirits	90/10	37
15	Tetrachloroethylene	5/95	18
	Tetrachloroethylene	10/90	19
	Tetrachloroethylene	20/80	25
	Tetrachloroethylene	30/70	33
	Tetrachloroethylene	40/60	25
20	Tetrachloroethylene	50/50	33
	Tetrachloroethylene	60/40	31
	Tetrachloroethylene	70/30	21
	Tetrachloroethylene	80/20	26
	Tetrachloroethylene	90/10	33

25 Example 10

The following tests demonstrate the use of cyclic dimethylpolysiloxanes as a solvent component in prewash spotting formulations used in home laundering.

30 Polyester fabric test pieces were prepared with approximately 1 inch diameter stains of used motor oil, cooking oil, and artificial sebum. Stains were heat set by placing the fabric in an automatic clothes dryer at the high temperature setting for two cycles of 60 minutes each. Each

1 stain was treated with 2 ml of the test fluid as described in
Example 1. Each fluid was left on the stain for one to two
minutes. The test fabric pieces were then washed in a
household automatic washer on the normal setting using the
5 recommended level of a powdered nonphosphate detergent. The
fabric pieces were dried in an automatic clothes dryer on the
permanent press setting.

The cleaned fabric pieces were rated visually for
the degree of stain removal according to the following scale:

- 16 5 = Complete removal
4 = Slight remaining stain
3 = Moderate stain remaining
2 = Slight removal of stain
1 = No change in stain

15 The ratings were made by comparison of the test pieces with a
standard series of exemplary stains in a black box using a
fluorescent light source.

The used motor oil tended to form a dual stain
containing a smaller sludge portion nearer the center and a
larger oil portion which spread out more from the point of
20 application. Some differences in the cleaning of the two
portions of these stains were observed and consequently the
cleaning of each portion was separately rated. The results
of the visual rating are presented in Table 10.

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1 TABLE 10: STAIN REMOVAL BY PREWASH SPOTTING

	Solvent	Stain			
		Motor Oil (Sludge)	Motor Oil	Cooking Oil	Artificial Sebum
5	A	3.0	5.0	4.5	5.0
	B	3.5	5.0	5.0	5.0
	C	3.0	5.0	5.0	5.0
	D	3.0	5.0	5.0	5.0
	$[(CH_3)_3Si]_2O$	4.0	5.0	4.9	5.0
10	Mineral Spirits	4.0	5.0	5.0	5.0
	Tetrachloroethylene	4.2	5.0	4.9	5.0
	Isopropyl Alcohol	1.0	5.0	3.5	4.0
	Xylene	3.0	5.0	5.0	3.3
	Polydimethylsiloxane 2 cs*	1.2	5.0	5.0	3.7
15	Polydimethylsiloxane 5 cs*	1.0	5.0	5.0	3.5
	Polydimethylsiloxane 10 cs*	1.0	5.0	5.0	4.0

*Trimethylsilyl endblocked linear dimethylsiloxane polymers

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1 Claims:

5 1. A method for cleaning textiles which comprises
applying to a soiled textile a liquid composition containing
an effective amount to aid soil removal of a cyclic siloxane
selected from the group consisting of octamethylcyclotetra-
siloxane, decamethylcyclopentasiloxane, and dodecamethyl-
cyclohexasiloxane and removing from the textile a combination
comprising soil and cyclic siloxane.

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 2. A method as recited in claim 1 wherein the
liquid composition contains 1 to 100 percent by weight of the
cyclic siloxanes.

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 3. A method as recited in claim 2 wherein the
liquid composition contains 5 to 100 percent by weight of the
cyclic siloxanes.

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 4. A method as recited in claim 3 wherein the
liquid composition contains 10 to 100 percent by weight of
the cyclic siloxanes.

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 5. A method as recited in claim 4 wherein the
liquid composition contains 30 to 70 percent by weight cyclic
siloxane and 30 to 70 percent by weight of cleaning solvent
selected from the group consisting of petroleum hydrocarbons
and chlorinated hydrocarbons.

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1 6. A method as recited in claim 5 wherein the
liquid composition contains cyclic siloxane and mineral
spirits.

5 7. A method as recited in claim 5 wherein the
liquid composition contains cyclic siloxanes and a
chlorinated hydrocarbon cleaning solvent.

10 8. A method as recited in claim 7 wherein the
liquid composition contains cyclic siloxane and tetrachloro-
ethylene.

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